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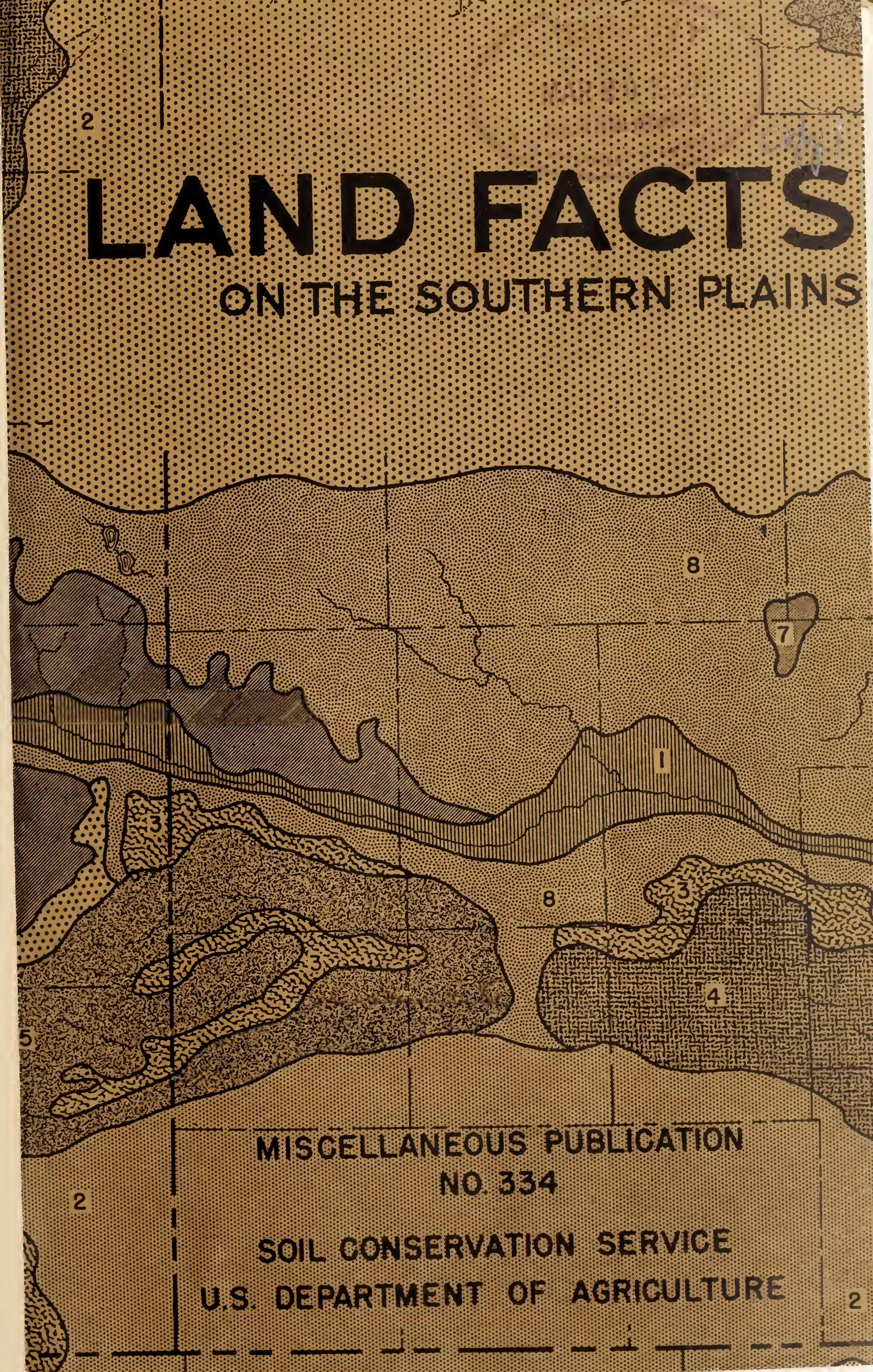
LAND FACTS

ON THE SOUTHERN PLAINS



MISCELLANEOUS PUBLICATION
NO. 334

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FOREWORD

THIS PUBLICATION deals with Region 6 of the Soil Conservation Service. Portions of five States—Kansas, Colorado, Oklahoma, Texas, and New Mexico—are included in this area, which is generally regarded as the southern Great Plains.

The text briefly describes the complex pattern of physical conditions as influenced by variations in climate and soil. The text also shows that the variations in physical factors provide complex problems which do not yield to a simple or single treatment.

The map attached to the back cover page shows 10 problem-area groups and divisions within some of these groups. These groups are areas in which there is a similarity of physical conditions which in turn affect the adaptation of crops and farming practices. It is neither a soils map, a rainfall map, a topographical map, nor even a land use map. Rather the map represents the first attempt to isolate and label those bodies of land where the soil, climate, and appropriate farming practices are somewhat similar.

H. H. BENNETT,
Chief, Soil Conservation Service.

LAND FACTS ON THE SOUTHERN PLAINS

* * *

BY GLENN K. RULE
Soil Conservation Service
in collaboration with specialists in soil conservation

UNITED STATES DEPARTMENT OF AGRICULTURE

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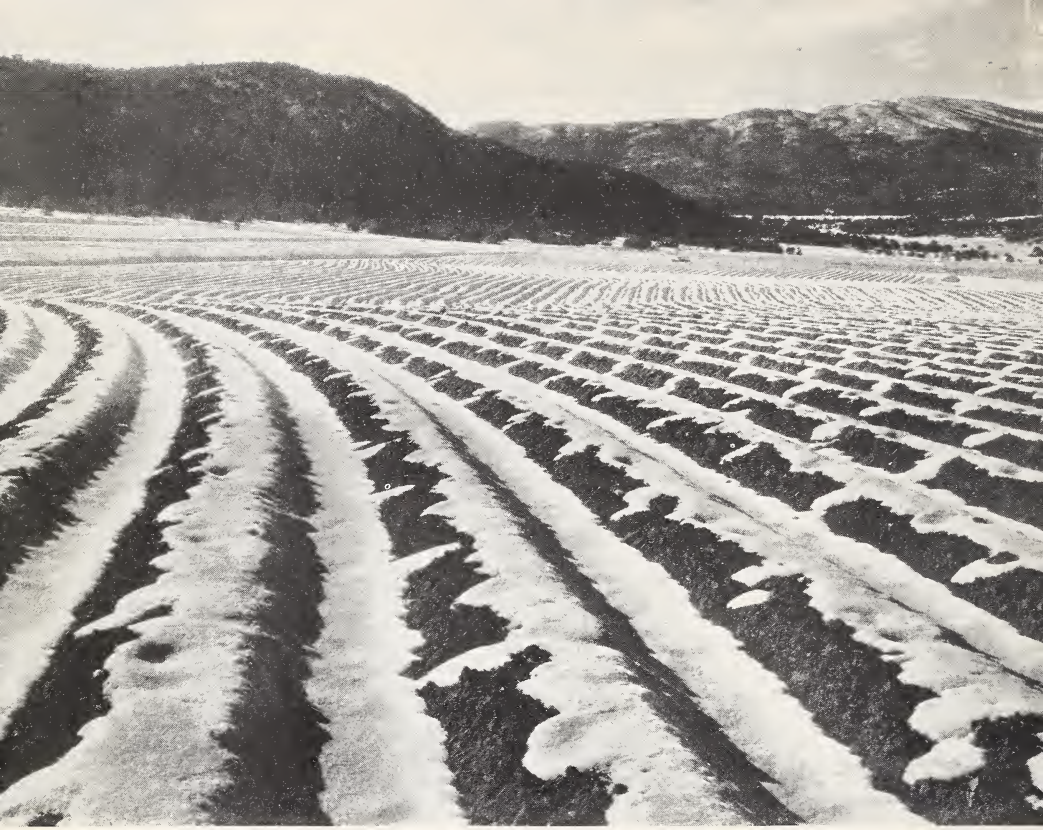


FIGURE 1.—On the Plains and westward the first need is to save for use every drop of rain or flake of snow the heavens grant.

Rich Soil Misused

The ninety-eighth meridian roughly marks the dividing line between humid and dry-land agriculture in the United States. This line, strung in a zigzag pattern, bears somewhat to the west as it swings downward from the Canadian border through the Dakotas, Nebraska, and Kansas to the flat boundary between the Texas Panhandle and western Oklahoma. The immense tableland, lying between this line and the base of the Rockies, usually receives scant rainfall, and the first need is to save for use every drop of rain the heavens grant (fig. 1).

Many of the early settlers chanced to strike the Plains in seasons of plentiful moisture and the land responded with abundant harvests. Others less fortunate struck years of drought and their attempt to employ the agricultural practices of the East proved disastrous. The entire period between occupation and the World War was checkered with prosperous years when rains fell and crop failure or near failure when the rains were sparse. But relatively little grass cover had been destroyed. When the dry years came, dust storms and soil drifting were common only in the isolated cultivated areas or around stock trails and watering places.

As the World War burst into being and more generous rains descended, wheat prices soared. High-powered tractors turned under the native sod with a surge and scope unparalleled in history. Destruction of the native grass cover, particularly in the extremely sandy areas, and the depletion of binding humus in the topsoil through continuous tillage, left the land in a condition to blow. Then a series of dry years came in the early 1930's. Successive crops failed, and in 1934 citizens of the Atlantic seaboard first saw dust clouds which had originated on the Plains in the West. Dust storms of equal severity occurred in 1936. The unprecedented movement of soil during these 2 years and the mounting relief load in the stricken areas served to focus the attention of the Nation on the problems of the Plains.

Wind and water have worked havoc with soil in the stricken areas because men there farmed in ways that were not in harmony with the climate, the lay of the land, and the make-up of the soil itself. Of course, the men of the Plains did not use wrong cropping methods because they would rather destroy their soil than save it. Many were helpless, caught in a mesh of economic circumstances. Driven by the need to get an income sufficient to pay their taxes, debts, and living expenses, they were forced to use the land in ways that exposed it to washing and blowing.

The Congress has authorized Federal helps to Plains farmers and other farmers in dealing with their economic problems, such as price of products, adequate credit provisions, and size of farms. State governments also have come into action with assistance wherever it may be afforded under the State powers. Farmers and Government are working together to bring about economic adjustments that will clear the way for physical adjustments in use of the land which must be made in the interest of a stable agriculture on the Plains. One of the objectives of this publication is to give a view of the physical conditions with which men must harmonize their ways of farming in the southern Plains.

Physical Conditions Vary Widely

Erratic and limited rainfall, high winds, high evaporation, wide variations in temperature and growing seasons—these are physical conditions that you find all over the Plains. This much is obvious; but the extremely wide variations in the soils are less apparent and are too often overlooked.

Most important among the soil characteristics are the differences in texture, structure, and depth. These differences give rise to the wide range in water-absorbing and water-holding capacity. Soils with fine-textured surfaces, usually found in clays and clay loams, retain water exceedingly well once water is absorbed. However, the rate of absorption, in the absence of water-saving measures, is so slow that much water runs off or is lost through evaporation. But even if such water-saving devices as contour tillage and terraces are provided, these soils may be moved by the wind if rainfall is insufficient to grow a cover of vegetation.

Sandy soils rapidly absorb a large percentage of the rainfall. Here the rain penetrates deeper than in the heavy or hard-land soils. On the other hand it is more difficult to raise big clods in sandy soils; and big clods, in the absence of vegetation, resist attacks by the wind.

The variation of soil types has a definite bearing on crop adaptations. Crops, such as wheat, are best adapted to the hard lands (fig. 2), while crops, such as cotton or sorghum, are usually grown more successfully on the sandy soils (fig. 3). The crop adaptations, in turn, have a definite bearing on the precise types of tillage methods and water-saving measures which might be employed.

Plains soils show other variations which have a marked effect on the amount of water that can be retained for the benefit of crops. Some areas are underlain with porous layers of gravel or coarse sand at varying depths beneath the surface. Other areas are underlain with dense or indurated subsoil layers known as hardpans or claypans. And, of course, the slope of the land has a marked effect on the amount of water that the soil can absorb.

No Panacea

Many well-intentioned people have prescribed panaceas for the ills of the Plains. Some said that soil drifting could be controlled by tilling the soil in such a way as to provide clod and furrow barriers against the wind. Others said it was a mistake to plow any sod in the first place and that all the land should be purchased by the Government and retired from use. Not a few said the cultivated acres should be retired to grass. Some pinned all their faith in terraces to conserve rainfall. There were those who said "all we need is rain" and there were others who urged the construction of huge dams in the few rivers that cross the Plains. Still others would solve the entire problem by increasing the land acreage under the operation of one man and his family.

FIGURE 2.—Wheat is usually grown more successfully on the hard lands than on the more sandy types.

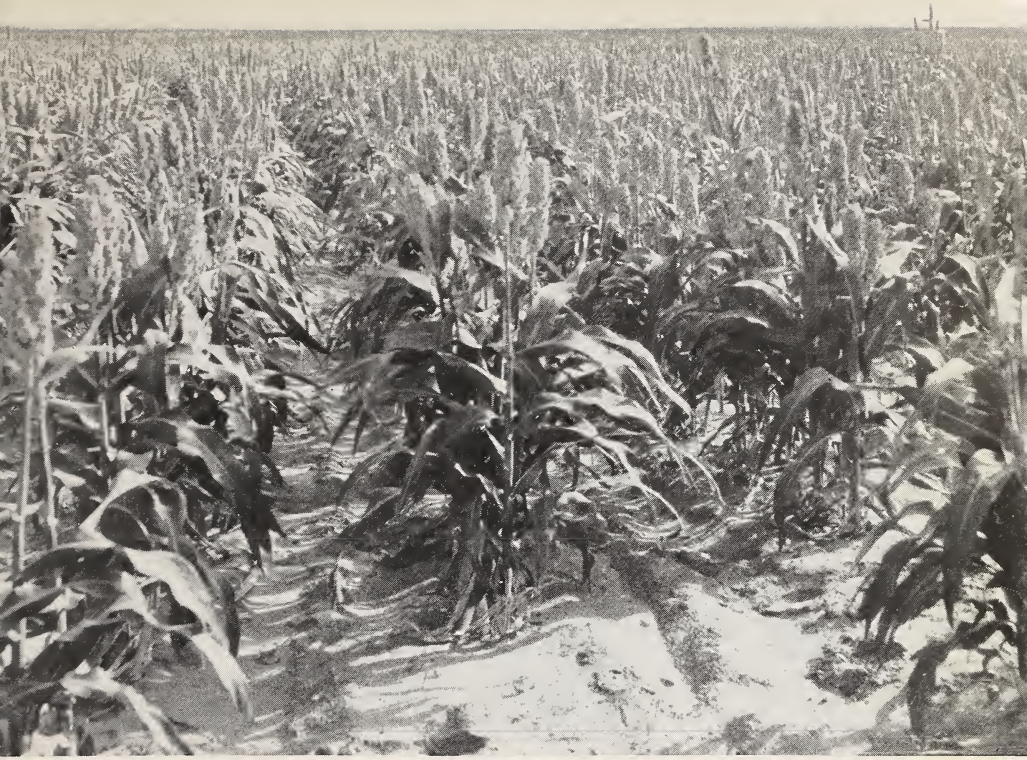


FIGURE 3.—Crops such as cotton or sorghum are usually grown more successfully on the sandy soils than on the hard lands. This field was severely eroded and in a hummocky condition in 1934 and 1935. The crop shown above was planted on the contour in 1936.

These ideas have merit. Each embodies, however, only a partial solution of a problem that is extremely complex. And the attempt to employ any of these single measures as a cure-all is no more feasible than an attempt to treat several human ailments with one drug.

Something of course can be said in defense of those who recommend cure-all methods. The casual observer in traveling across the Plains from east to west, or north to south, may detect few differences other than in the spots where generous rains have fallen. Viewed from a car window the changes in vegetation, topography, and soil conditions appear so gradually that they are scarcely discernible. And so,

FIGURE 4.—A careful inventory of physical conditions on the Plains is necessary before the problem can be attacked intelligently.

when the casual observer reflects that the whole region receives erratic and limited rainfall, that high winds, unimpeded by topography or trees, are characteristic, he is easily led to believe in a simple solution.

But the farmer who attempts to make a living on the Plains, or a governmental agency that assists in the determination of sound physical land use practices, is obliged to penetrate beyond casual impressions.

To survive on the Plains for any great length of time, the farmer must harmonize his operations with opportunities and handicaps of the natural environment. And the Government, as trustee for society's interest in the perpetuation of soil values, is equally concerned with sound measures of soil defense. All this suggests that no sensible attack can

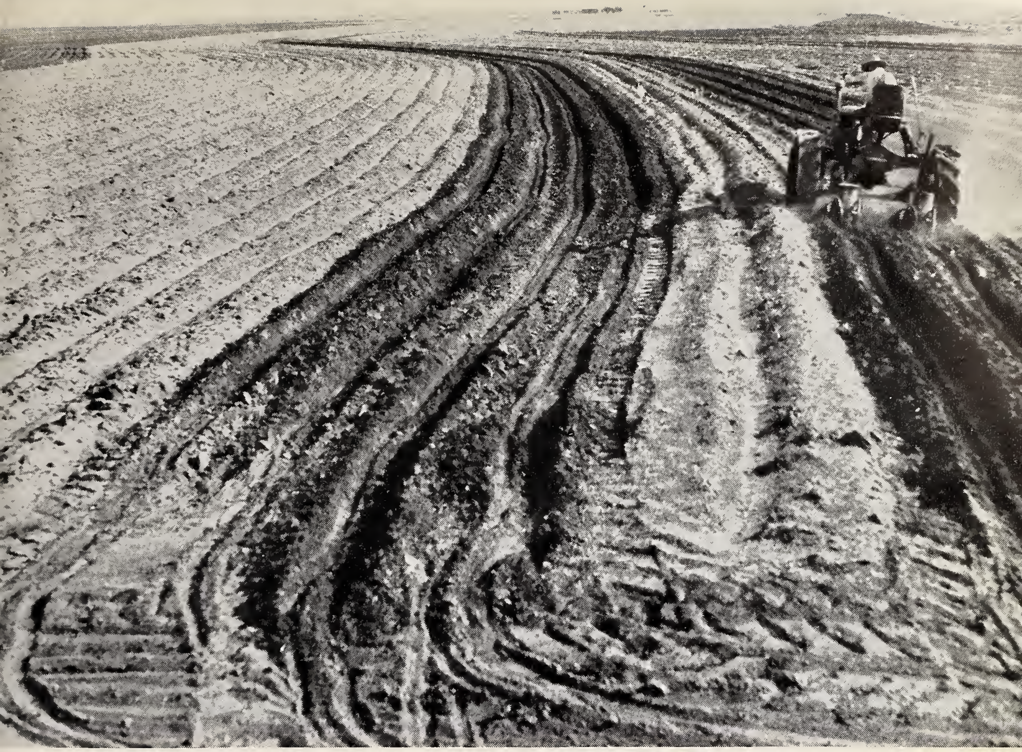


FIGURE 5.—Total acreage in demonstration areas in the southern Plains exceeds 900,000 acres.

be made on the problems of the Plains without first making a careful inventory of all physical factors that contribute to the complexity of the problem (fig. 4). Remedial measures that are appropriate in one area of the Plains may be disastrously inappropriate in another.

Back to Cover

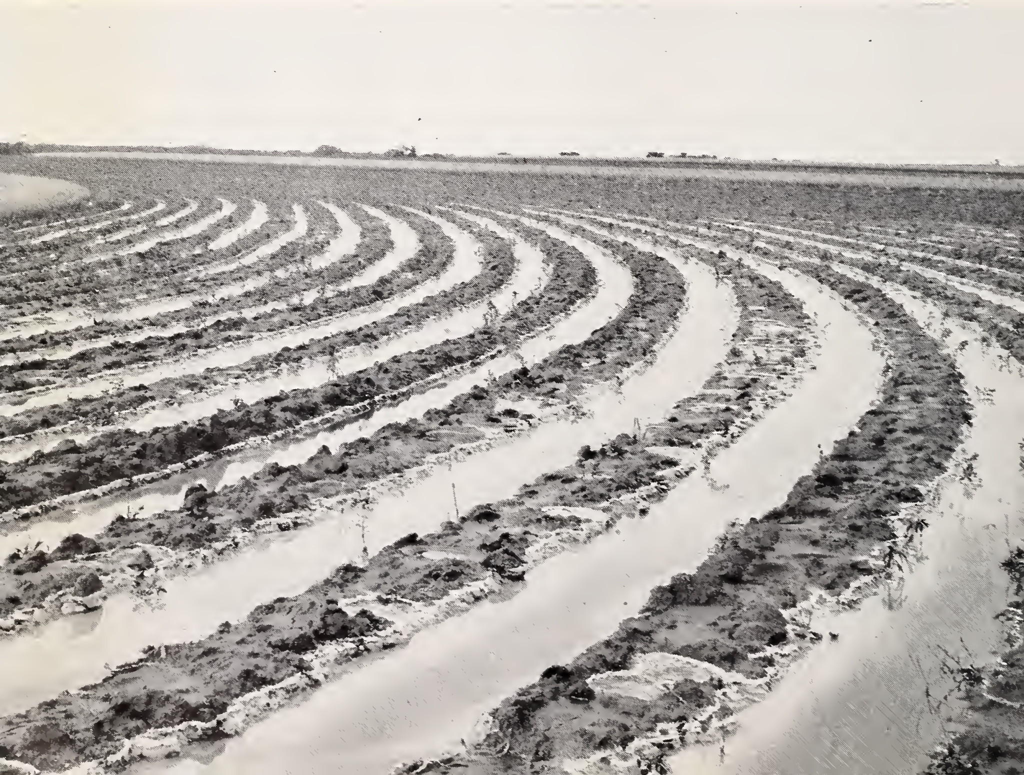
In the late months of 1934 and early in 1935, the Department of Agriculture established numerous areas throughout the United States where the best-known soil- and water-saving measures could be demonstrated upon representative agricultural lands. Twelve of these project areas were established in the southern Plains. In addition, work crews from 14 Civilian Conservation Corps camps put in effect erosion-control practices on other areas within the region. The total acreage in demonstration areas, including both projects and camps, exceeds 900,000 acres (fig. 5).

Once a project area was selected, the farms of all the cooperating farmers were surveyed to determine the degree of erosion, the present land use, the slope of the fields, and the characteristics of the soil. The results of these surveys were used as a basis for planning an erosion-control program for the entire area.

To put it all into one word, *cover* is the goal. Successful crops provide good cover while they are growing; crop residues, stalks, and stubble provide protection when no crop occupies the land; and to the extent that grass is improved on range land, that land is protected.

But to attain cover, either through successful crops on cultivated land or an improved turf on grasslands, every

FIGURE 6.—These furrows, swerving to the contour of the field, hold water where it falls for the benefit of crops.



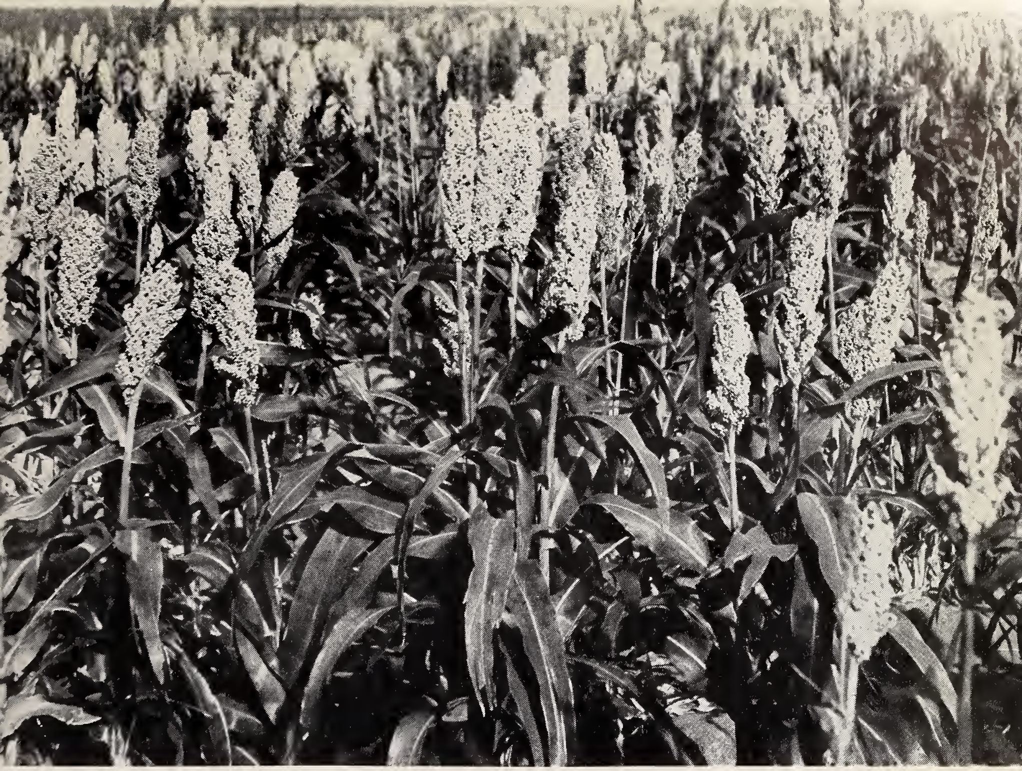


FIGURE 7.—Water-saving and protective measures are determined by the needs of the land. This field, after the hummocks were leveled, required nothing more than rough tillage on the contour to put it in condition to take water. And it took enough water to grow the crop shown above.

provision must be made to sink rain into the soil where it falls (fig. 6). The supply is so scanty that the farmer cannot afford to lose a drop unnecessarily through run-off or evaporation.

The needs of the land determined decisions as to water-saving and protective measures. Some cultivated fields required terracing to make the most efficient use of water. Others, particularly sandy fields best adapted to row crops, required nothing more than rough tillage on the contour to place them in condition to take water (fig. 7). Contour furrows were planned on the gently sloping range lands to prevent run-off (fig. 8). In places where water could not

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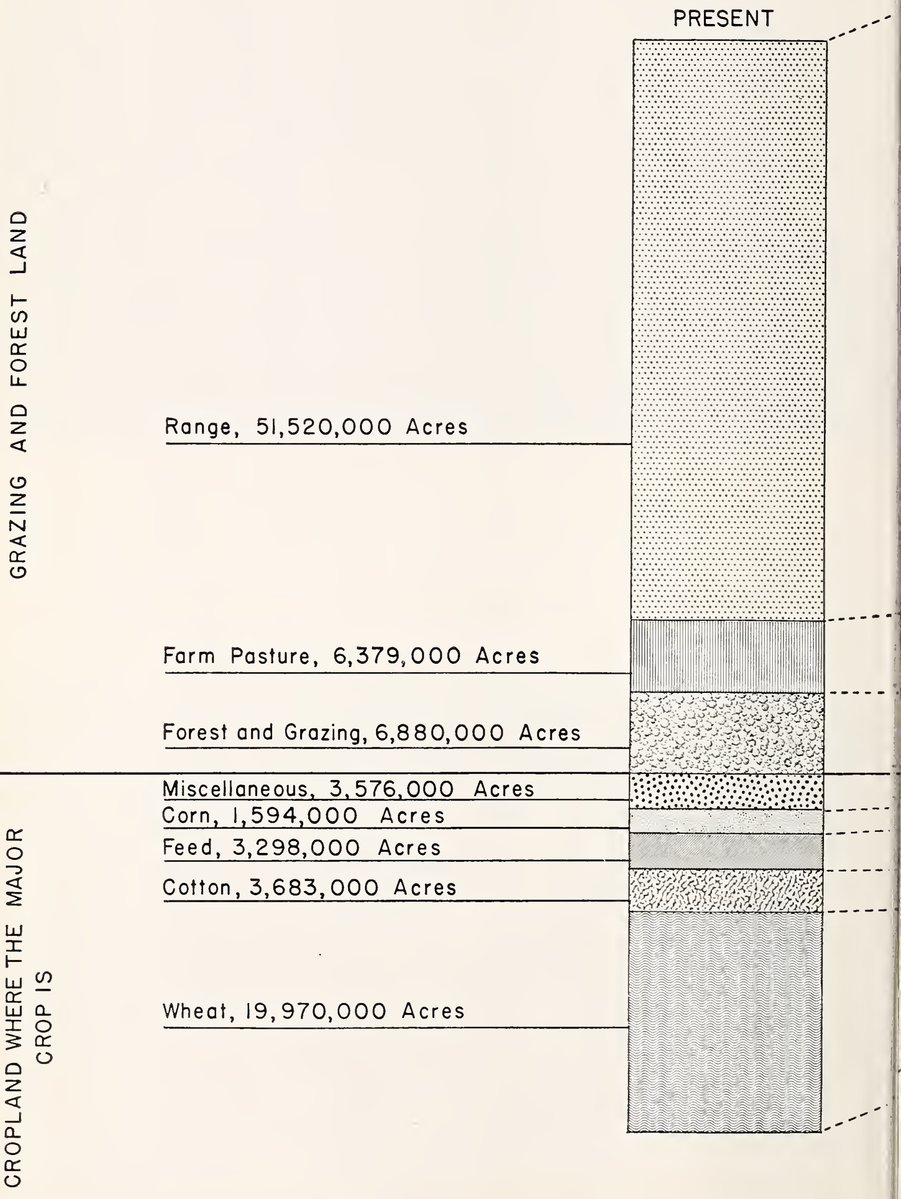
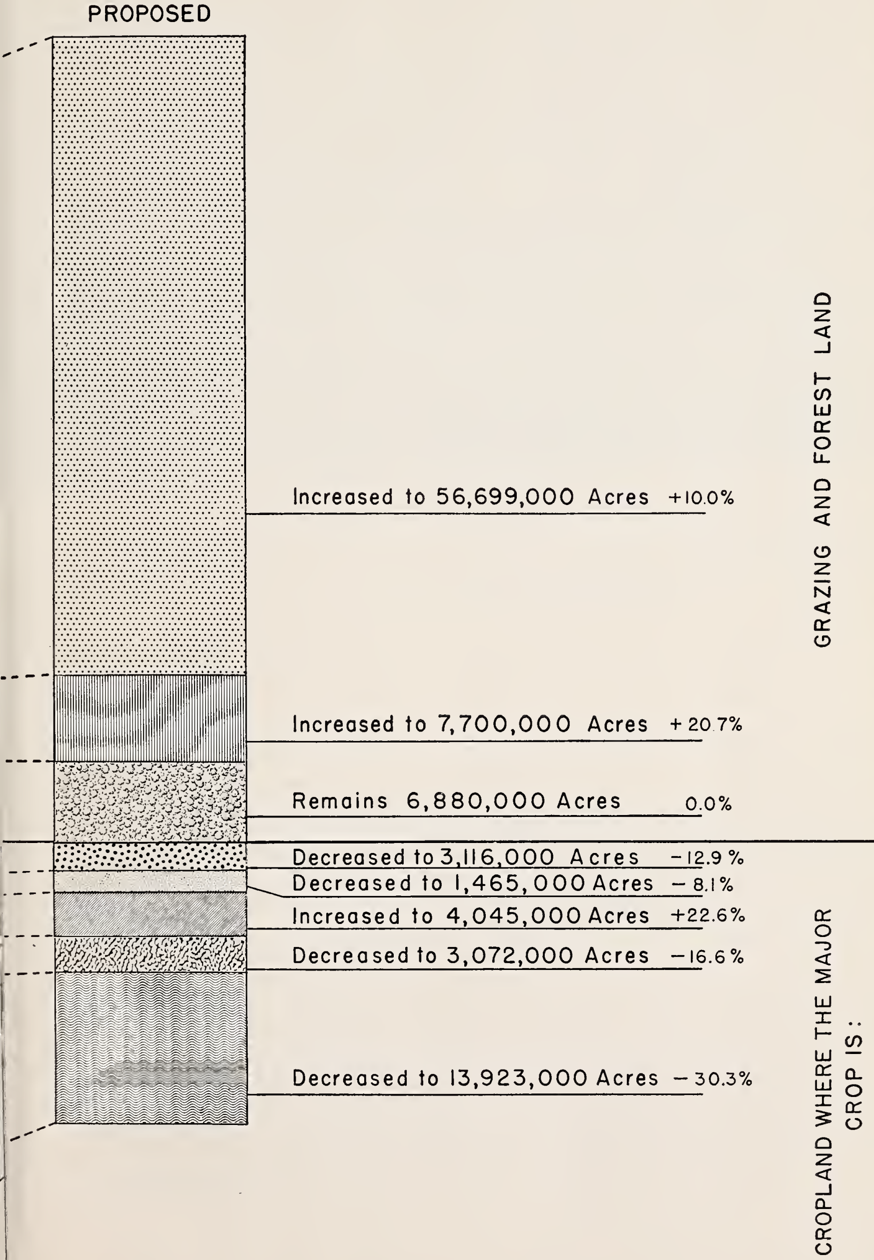
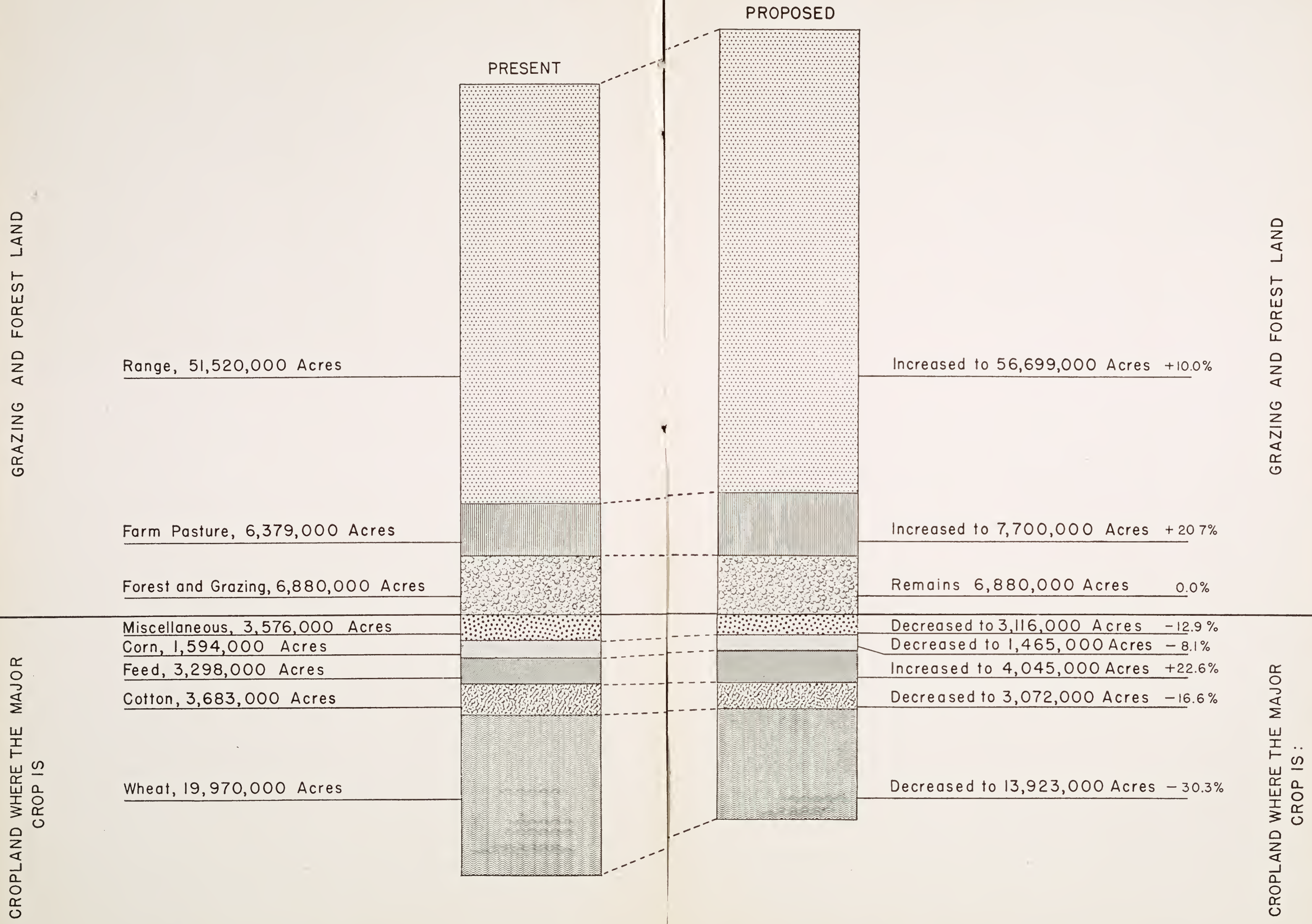

PRESENT
GRAZING AND FOREST LAND
Range, 51,520,000 Acres
Farm Pasture, 6,379,000 Acres
Forest and Grazing, 6,880,000 Acres
CROPLAND WHERE THE MAJOR CROP IS
Miscellaneous, 3,576,000 Acres
Corn, 1,594,000 Acres
Feed, 3,298,000 Acres
Cotton, 3,683,000 Acres
Wheat, 19,970,000 Acres

USE


PROPOSED
Increased to 56,699,000 Acres +10.0%
Increased to 7,700,000 Acres +20.7%
Remains 6,880,000 Acres 0.0%
Decreased to 3,116,000 Acres −12.9 %
Decreased to 1,465,000 Acres − 8.1%
Increased to 4,045,000 Acres +22.6%
Decreased to 3,072,000 Acres −16.6 %
Decreased to 13,923,000 Acres − 30.3%
GRAZING AND FOREST LAND
CROPLAND WHERE THE MAJOR CROP IS:

LAND USE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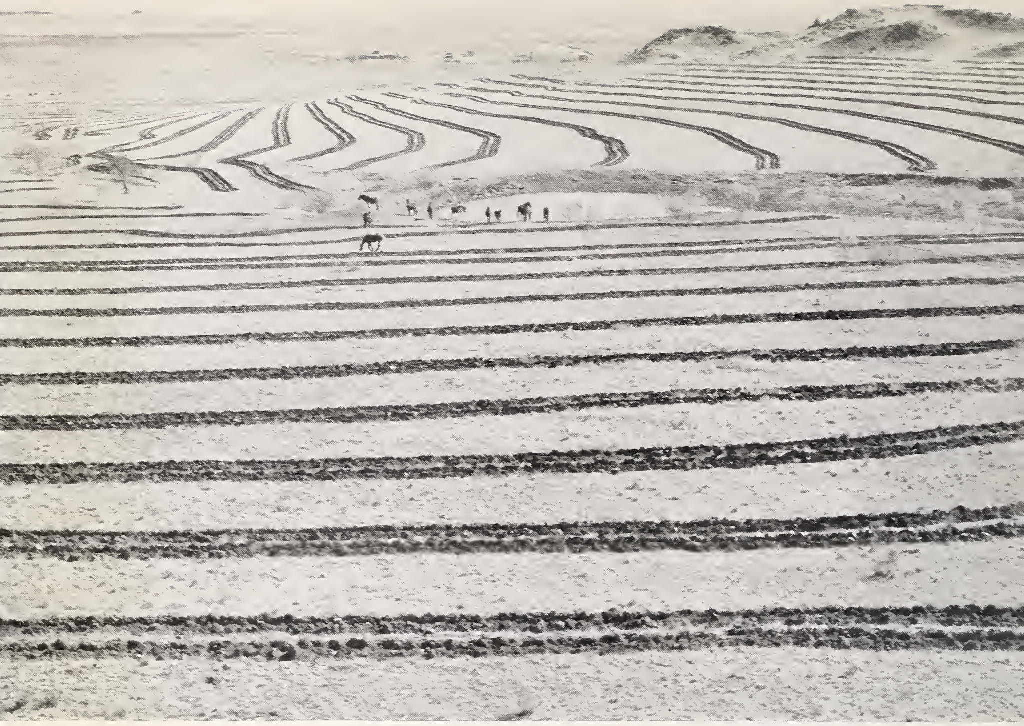


FIGURE 8.—Stock tanks and furrows on a Texas pasture. The stock tank, built in a gully, provides additional watering facilities and helps to distribute grazing animals more evenly over the range. The contour furrows help to keep water where it falls; the excess is caught in the tank.

be used where it falls, such as on the steep escarpments at the foot of the Rockies, plans were made to catch and spread this water on the lowlands for the benefit of grass or native hay. On all range lands a plan of controlled grazing was adopted and numerous livestock watering places were planned to provide more uniform grazing and to keep from concentrating trampling hooves that destroy cover. In short, the plans for each farm represented an elastic combination of control practices. The plans were patterned to fit the field just as a tailor fits or alters a suit of clothes for a man.

FIGURE 9.—During the 3-year period (1935–37) not a single demonstration area in the southern Plains had received the average amount of rainfall expected. Most of the crops in the demonstration areas, including the one above, were obtained on rainfall that has not exceeded 12 inches.

In January 1938 an estimate of the land cover was made on all of the 26 areas where control operations had been placed in effect during the previous 3 years on the 900,000 acres. It was found that only a little over 100,000 acres were without sufficient cover to prevent serious damage by the wind. Some of the areas had received more rain than others.

But not a single area during that 3-year period had received the average amount of rainfall expected on the Plains. (Average rainfall varies with localities from less than 15 inches to a little over 20 inches.) *Most of the crops on the demonstration areas were obtained on rainfall that has not exceeded 12 inches* (fig. 9).

Spreading the Cover

While these demonstration areas present a hopeful transformation from instability to relative stability as compared with areas where no control measures have been adopted, it is generally recognized that a larger problem remains. This larger problem is the task of providing cover and bringing other agricultural practices into adoption on the much larger areas of land that surround the demonstrational spots. The demonstrational areas represent about 1 percent of the land in the region. This proportion can be visualized by dropping the familiar paper card of matches on the top of a fair-sized table.

And do not think that these scattered demonstration areas yield the answer to all the problems of control. Only a start has been made. Research, afield, is still needed. Different types of terraces, for example, are under study as are the widths for strip cropping. Different methods of pasture furrowing are under observation to determine their relative value and efficiency (fig. 10). One of the most difficult problems is to find successful methods of reestablishing grass on land to be retired from cultivation. Still another problem is to find an adapted grass to include in the rotation of cultivated crops.

Yet with all the refinements in control measures and the alterations in recommendations that are sure to be made as time goes on, the results obtained in the demonstration areas have shown that no one prescription can solve the physical land use problems of the southern Great Plains.

Early in 1936 the Department of Agriculture concluded on the basis of experience, that while demonstrations can point the way, sufficient progress in erosion control cannot be made unless it becomes possible to treat whole bodies of land. Protection here and there in a blow area benefited the owners or operators of the treated fields and farms; but it did not stop the loss from neighboring unprotected fields.

In seeking a democratic method whereby landowners and operators could spread the use of erosion-control methods,

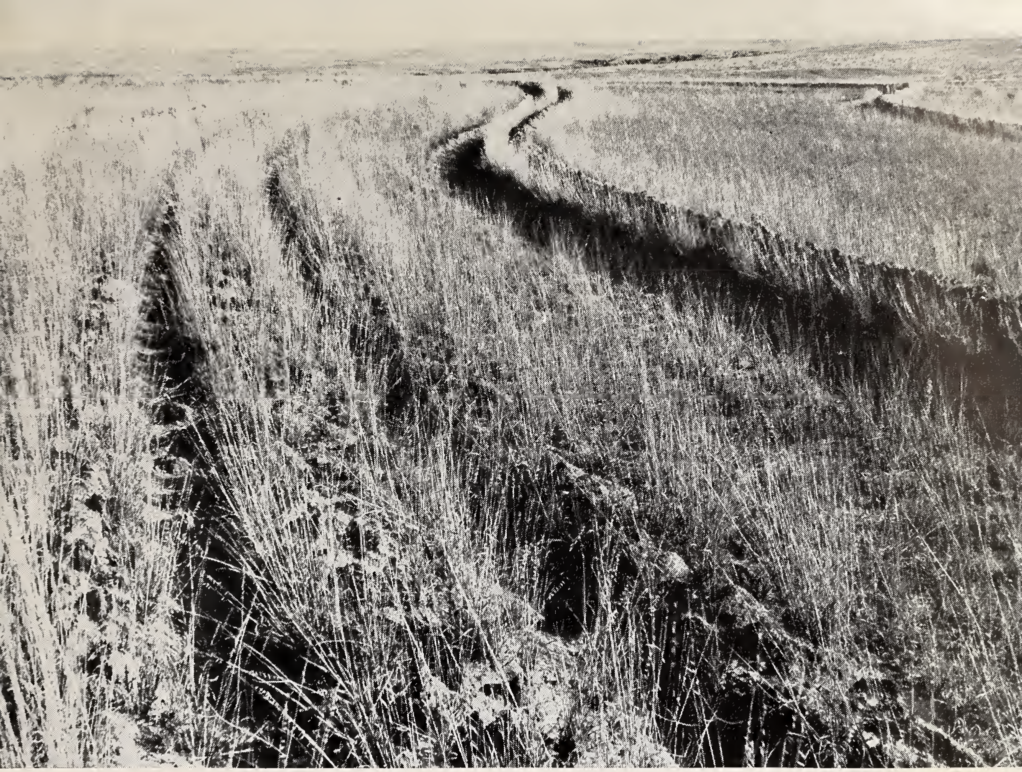


FIGURE 10.—While most methods of pasture furrowing have proved successful there are various types that are still under observation to determine their relative efficiency.

the Department suggested that the States pass in their legislatures enabling acts establishing conservation districts for soil-erosion control. (See Soil Conservation Districts for Erosion Control, U. S. Department of Agriculture Miscellaneous Publication No. 293.)

We Need More Facts

Faced with the job of recommending appropriate practices to the governing bodies of the newly formed soil conservation districts, so that sound methods could be given wide adoption, technicians found that we needed more facts about the region as a whole. No one knew, for example, how much good wheatland was under cultivation in the region. No one knew how much of the cultivated land was best adapted to sorghum and row crops. No one knew how much cultivated land was of such a sandy nature that it should be retired to grass as quickly as possible. No one knew how much native grassland could safely be broken for wheat or row crops if there was any justification for such use. Furthermore, no one knew what proportion of the total area had been broken for cultivation.

To get such needed facts, the Soil Conservation Service undertook the first extensive and complete survey of physical conditions that affect the agriculture of the southern Plains. The survey is now complete. Its findings have been recorded in text and in a map of the entire region showing those areas in which physical conditions are similar and in which certain crops are best adapted. Recommendations are based not only on the experience of the Soil Conservation Service field staff but also on results secured by successful farmers and the many years of research by State and Federal experiment stations.

The surveyors found that they could show the physical conditions in the region under 10 major classifications. These 10 classifications are termed "problem-area groups" and these groups are distinguished by different combinations of physical factors. Chief among the physical factors considered are: (1) Soils, with emphasis on depth, texture, and productivity, but including moisture relationships, infiltration, and run-off rates; (2) physiography, with emphasis on topography, relief, drainage, and geology; (3) erodibility and erosion conditions; and (4) climate.

Table 1 gives the group numbers, a brief description, the acreage, and the percentage of land in each major group.

TABLE 1.—*Description, acreage, and percentage of land in each major group in Region 6*

Problem-area group		Area	
Classification No.	Description	*Acres*	*Percent* [1]
1	Alluvial soils	1,170,000	1.2
2	Deep moderately heavy cropland	16,620,000	17.2
3	Deep moderately sandy cropland	3,720,000	3.8
4	Grazing and feed crop area with medium-depth soils	11,000,000	11.4
5	Deep sandy row-crop land	12,230,000	12.6
6	Shallow grazing land	23,000,000	23.7
7	Loose sand and sand-hill areas	8,530,000	8.8
8	Very heavy clay soils suitable only for grazing	1,970,000	2.0
9	Rough, broken, and stony land	9,280,000	9.6
10	Mountain areas	6,880,000	7.1
	Irrigated areas	2,500,000	2.6
	Total	96,900,000	100.0

[1] Percentage of land in terms of total area of Region 6.

The problem-area group, as here interpreted, is based on a set of physical conditions which are combined to create a specific and definite problem that requires appropriate and logical treatment. Three of the major groups (Nos. 2, 3, and 5) are further subdivided on the basis of distinct climatic variations which affect crop adaptations and types of erosion.

For example, the major group No. 5, which includes those areas that are classified as deep sandy row-crop land is further broken down into four subgroups. The subgroup 5*a* is characterized by a high elevation and a short growing season and is best adapted to corn and beans; 5*b* is a typical feed-crop area; 5*c* includes the High Plains cotton lands which are favored with a long growing season; 5*d* includes cotton lands of low elevation but which are also favored with a long growing season. In the subgroup 5*c* wind erosion is the most serious problem, whereas in 5*d* both wind and water erosion are prevalent.

While the soil textures, slope, land relief, water relations, and other physical factors are similar in each of these four subgroups, the climatic influences on crop adaptations make it necessary to give special consideration to crop factors in devising a program.

The term "problem-area group" does not refer to critical areas alone, nor does it refer to a single body of land. Rather, each group is composed of a number of well-defined areas, large and small, on which not only the physical conditions are similar, but on which the soil, moisture-conservation, and erosion problems are similar.

The map makers and soil technicians found an intricate task when they attempted to isolate various lands into the groups as described above. Their problem shows how complex is the agriculture of the Plains. It would be possible of course to construct a map which would disregard many isolated areas of land wherein the physical conditions are somewhat different from those in the larger territories which surround them. One could, for example, in bold strokes mark off the Plains cotton section in the lower Texas Panhandle; then mark off the range area as a long finger which hugs the Rockies on the west from eastern New Mexico up through Colorado to the southern boundary of Wyoming; then divide what is left of the region between range lands, wheatlands, and lands in sorghum, where these uses predominate. But any map simplified to this extent would hamper instead of help in developing a sound program of soil defense. It would look clear-cut and plain, but it would not be true. The problem is by no means simple. The map cannot be simple.

With all their zeal in making a map that will show significant details, the soils men cannot show variations farm by farm. The scale of mapping will not permit that. The land on each farm speaks for itself and speaks first of all to the ones who know it best—those who live on it.

The New Map

However, one can lay this map on his knees when crossing the Plains by car or train and by its use detect many of the boundary lines of the various areas. (See the map attached to the back cover page.) The map and the information necessary for its construction have been used in two significant ways. One was for land use planning and the other for the determination of the extent to which erosion-control practices could be applied.

The diagram in the center of this publication tells how the information has already been employed in land use planning. The chart on the left-hand page shows the way in which the 96,900,000 acres in the region are now being used. The chart on the right-hand page shows the proposed or improved use.

If you will compare the two charts, you will see that no sweeping change in the pattern of agriculture for the region as a whole is proposed. Possibly the greatest shift is the retirement to grass of 6½ million acres of cultivated land. Most of this acreage was either unsuitable for cultivation in the beginning or it has been so affected by erosion that it is no longer worth cultivating. This shift would reduce the cultivated land to a little over 25 million acres and increase the grazing land to a little over 71 million acres.

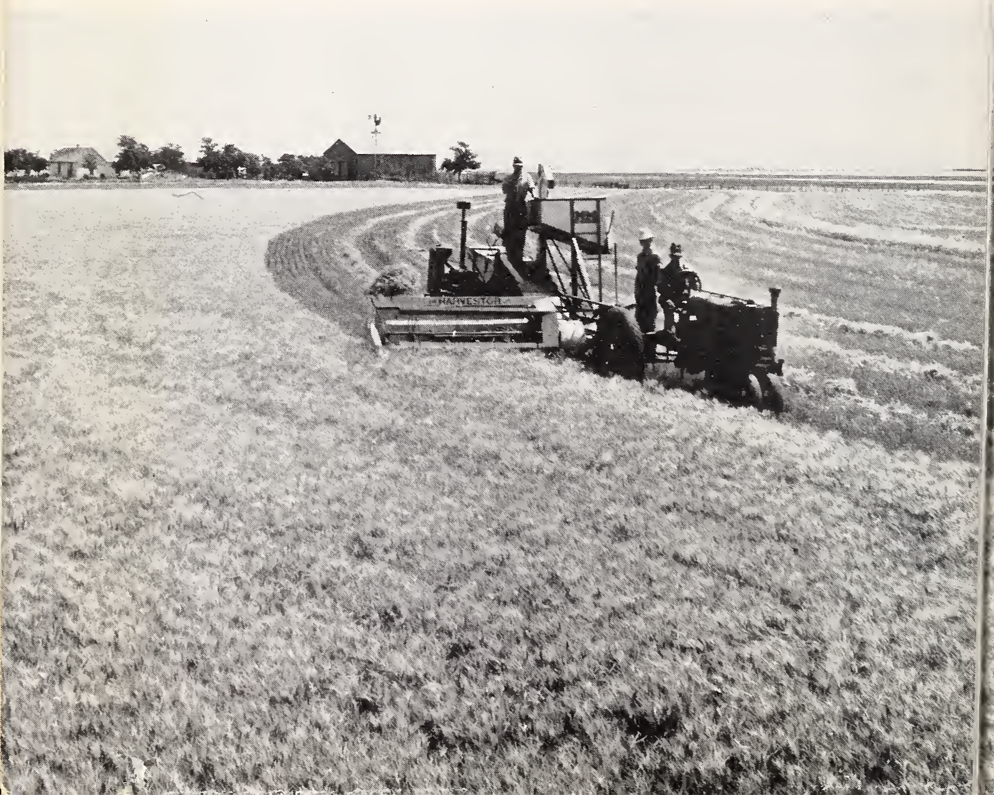
There are areas within the region, however, where definite and decisive shifts are recommended. In some of these areas the land has been devoted to wheat production which should always have remained in grass. And in other places wheat has been grown on land that is better adapted to feed crops.

The recommendations for changes in the region do not necessarily reveal the pattern of land use for any one year. On the typically good wheatlands it is recommended that this crop be grown only when fall moisture and fertility conditions warrant the attempt. When soil moisture is insufficient in the fall the row-crop acreage in the following spring would be increased. When fall moisture conditions are good the row-crop acreage the following spring would be decreased. Of course, year by year the adjustments necessary under the national programs for price and income stability will also influence the pattern of land use.

Some authorities in the southern Plains feel that perhaps a greater acreage of cultivated land should be retired to native grasses than is indicated on the proposed land use chart. The recommendations are given under the assumption that water-saving methods and other improved agricultural practices will be widely adopted. If improved methods are not brought into general use the only alternative is to retire more acres to grass. If and when an adapted sod-forming crop has been found for the southern Plains, its use in the various cropping systems would cause a further reduction of the cultivated acres.

As useful as the map and related information may be in pointing the way for a more appropriate use of the land in the southern Plains, an even more striking opportunity remains. We have still to explore with care the unused water resources of the region. The map and data show that terracing is needed on more than 20 million acres of cultivated land and that contour farming alone is needed on 3 million acres additional (fig. 11). Of the 64 million acres of grazing land the survey shows that over 34 million acres could be benefited by contour furrows or ridges and that over 8 million additional acres could be improved with water-spreading systems

FIGURE 11.—The map and data show that terracing is needed on more than 20 million acres of cultivated land.



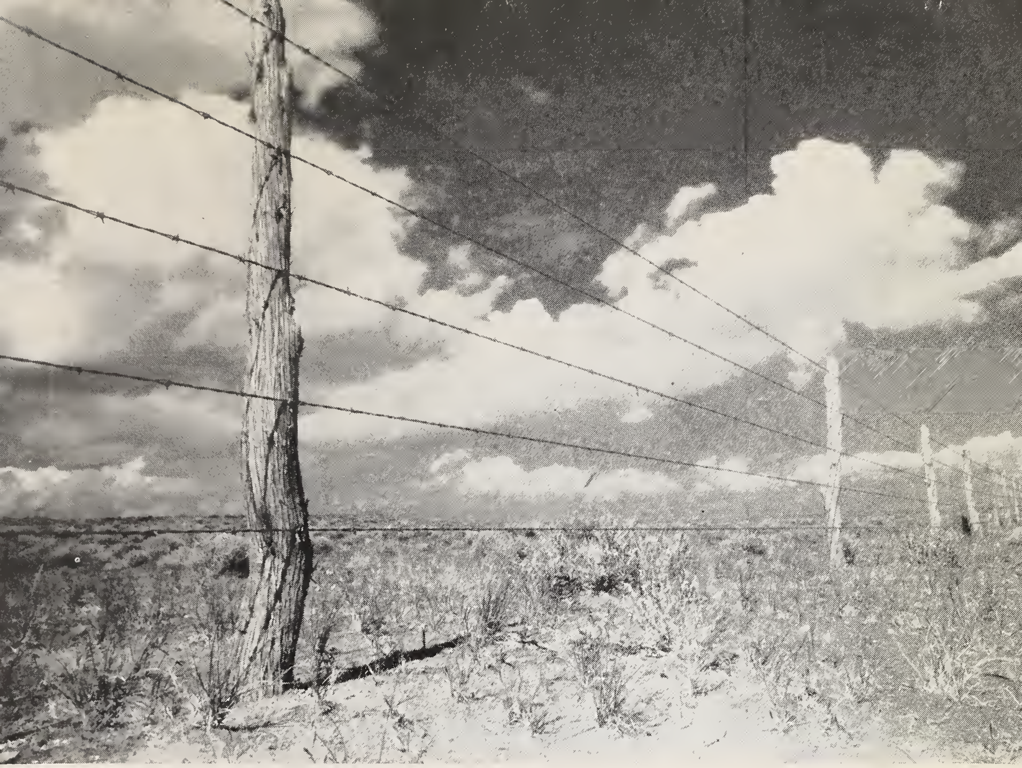


FIGURE 12.—Of the 64 million acres of grazing land the survey shows that over 34 million acres could be benefited by contour furrows or ridges.

(fig. 12). Usually enough rain falls to make crops more certain, if only those raindrops can be held, more and more, in the ground where they fall. Soil technicians term that "deposits of water." And nowhere, though only in scattered spots as yet, have deposits of water made a more heartening yield of food and protecting cover, than on the southern Plains. But here, too, we need facts—far more facts than we have at present; and a far wider cooperation in safe cropping practices.

In Conclusion

The purpose here has been to reveal the complexity of the agricultural problem in the southern Great Plains, the consequent futility of placing reliance upon panaceas, and to stress in closing, that the job can be done.

Combinations of physical conditions vary widely. Controls and cures that work well under one set of conditions are disastrous failures under others. It follows that no sustained progress toward solving the ills of the Plains can be expected without fact-finding surveys and a course of action that is based on correct diagnosis. In this, the working farmers themselves can help enormously.

This is not to say that farmers should not go out in pelting grit and throw up temporary barriers against the wind when the soil begins to move. Neither does it imply that the Government should not take steps to rescue dying cattle and relieve human distress. But the greatest concern, on the part of the farmer and the Government, is to reduce the frequency and scope of distressing emergencies.

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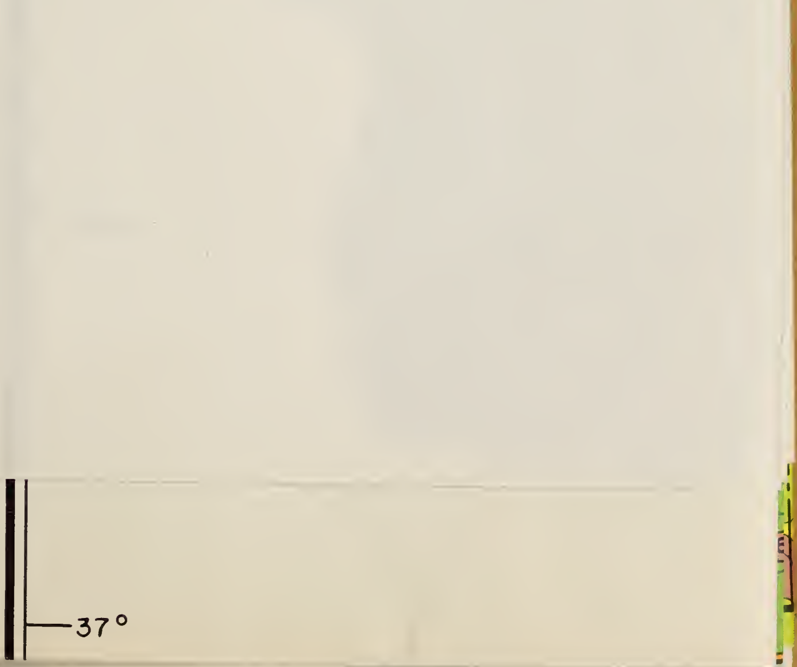
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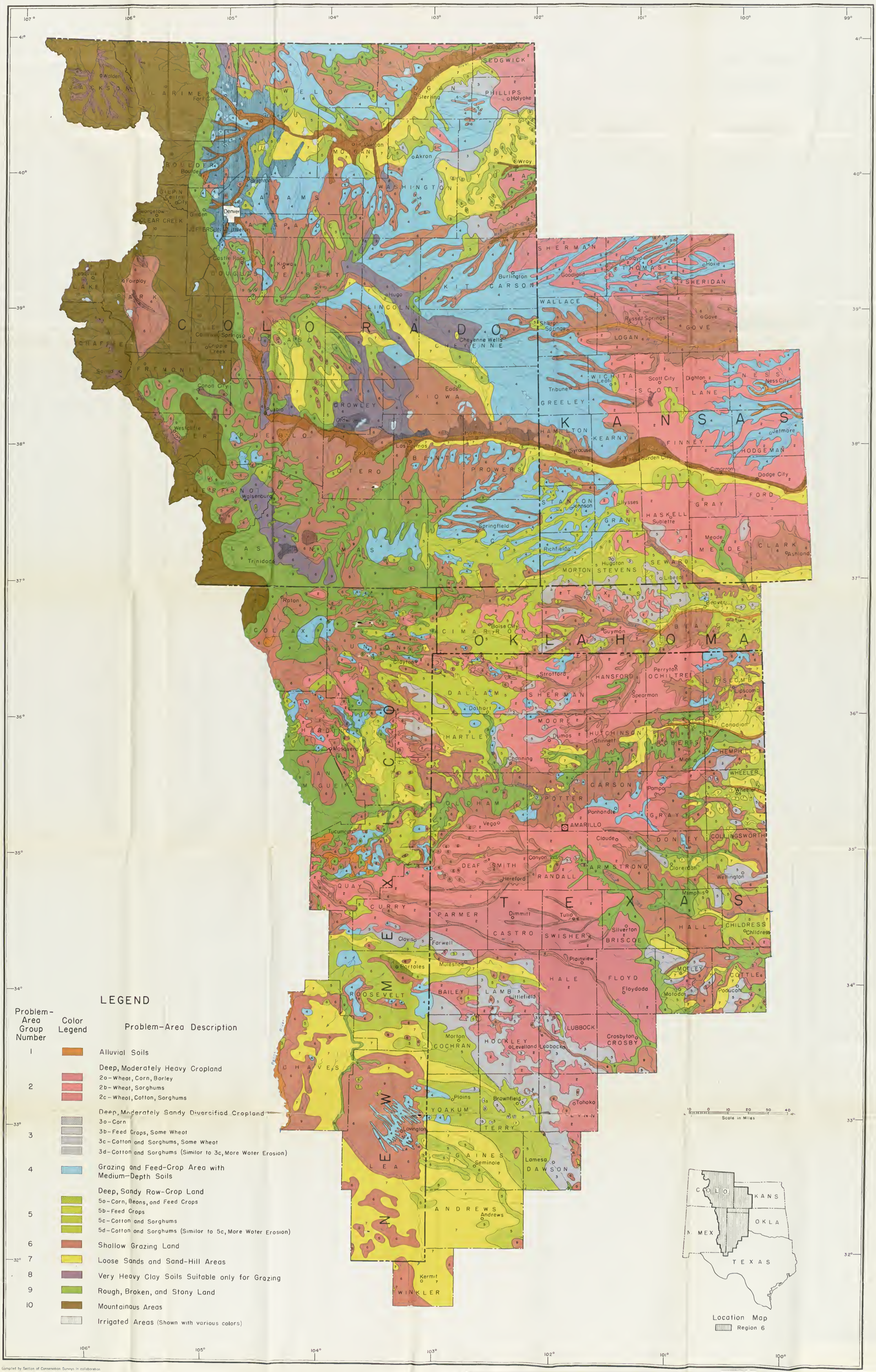
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. BENNETT, CHIEF

SOIL CONSERVATION PROBLEM-AREA GROUPS

BASED ON PHYSICAL FACTORS

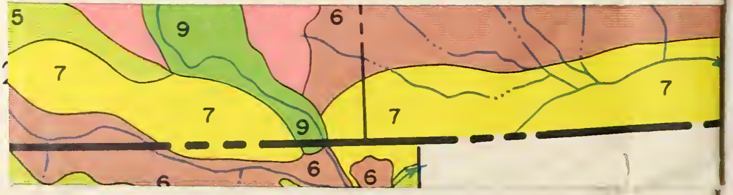
REGION 6
Comprised of portions of Colorado, Kansas, Texas, New Mexico, and Oklahoma.



LEGEND

Problem-Area Group Number	Color Legend	Problem-Area Description
1	🟧	Alluvial Soils
2		Deep, Moderately Heavy Cropland
	🟥	2a-Wheat, Corn, Barley
	🟥	2b-Wheat, Sorghums
	🟥	2c-Wheat, Cotton, Sorghums
3		Deep, Moderately Sandy Diversified Cropland
	▨	3a-Corn
	⬜	3b-Feed Crops, Some Wheat
	⬜	3c-Cotton and Sorghums, Some Wheat
	⬜	3d-Cotton and Sorghums (Similar to 3c, More Water Erosion)
4	🟦	Grazing and Feed-Crop Area with Medium-Depth Soils
5		Deep, Sandy Row-Crop Land
	▨	5a-Corn, Beans, and Feed Crops
	🟩	5b-Feed Crops
	▨	5c-Cotton and Sorghums
	🟩	5d-Cotton and Sorghums (Similar to 5c, More Water Erosion)
6	🟥	Shallow Grazing Land
7	🟨	Loose Sands and Sand-Hill Areas
8	🟪	Very Heavy Clay Soils Suitable only for Grazing
9	🟩	Rough, Broken, and Stony Land
10	🟫	Mountainous Areas
	▥	Irrigated Areas (Shown with various colors)

Compiled by Section of Conservation Surveys in collaboration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